3.0 AFFECTED ENVIRONMENT

3.3 Soils, Geology, Mineral and Energy Resources

3.3.1 Soils and Geology

The Coachella Valley is located in the northwestern portion of a broad, tectonic depression known as the Salton Trough, which is approximately 130 miles long and 70 miles wide and extends from the Gulf of California to the San Gorgonio Pass. The Salton Trough is actually the northern portion of the Gulf of California, a rift basin formed by oblique strike-slip motion between the North American and Pacific tectonic plates. Given its geologic position, the Coachella Valley region is highly susceptible to seismically-induced and other geologic hazards.

Regional Soils and Surficial Rocks. The valley includes a diverse range of rocks and sediments, which were formed or deposited over millions of years. The oldest rock formations are basement rocks, which compose the mountain ranges bordering the valley. Mountains of the Peninsular Range geologic province, including the San Jacinto and Santa Rosa Mountains, are composed of fairly old (Mesozoic) granitic rock, which has intruded even older metasedimentary rock of Mesozoic and Paleozoic age.[1] Mountains of the Transverse Range province, including the San Bernardino, Little San Bernardino and Orocopia Mountains, consist of a pre-Cenozoic crystalline basement complex, which is primarily composed of batholithic granite that has intruded numerous pendants of metamorphic rock.[2]

Over millions of years, the Salton Trough has been filled with sedimentary deposits up to 20,000 feet thick. Various sedimentary layers, or formations, are exposed throughout the Coachella Valley, particularly in the Indio and Mecca Hills and near Whitewater Canyon. The oldest sedimentary formation, known as Coachella Fanglomerate, is composed of debris-flow and stream-laid deposits of gneiss, granite, and volcanic rock.[3] The Imperial Formation, which is probably of early Pleistocene age, was deposited when the Gulf of California extended into the northern reaches of the Coachella Valley and contains marine fossils in its sandstone layer. Ocotillo Formation, which is extensively exposed in the Indio and Mecca Hills, is largely composed of cobble, gravel, and sand containing granite and metamorphic units.

The most recently laid sediments in the region are alluvial (stream-deposited) and eolian (wind-deposited) sediments. Alluvial sediments typically consist of gravel, sand, and clay deposited by mountain streams and found within alluvial fans and the lower reaches of mountains canyons. In the vicinity of the Salton Sea, they consist of fine clay

1 "Emerging Perspectives of the Salton Trough Region with an Emphasis on Extensional Faulting and its Implications for Later San Andreas Deformation," Eric G. Frost, Steve C. Suitt, Mitra Fattahipour.
2 "Geology of the Southeastern San Andreas Fault Zone in the Coachella Valley Area, Southern California," Thomas W. Dibblee, Jr.

3 Ibid.

that is probably lacustrine (lake) in origin. Eolian deposits are silty sand and fine and medium-grained sand fractions that are transported by strong, sustained winds emanating from the San Gorgonio Pass.

Seismic Activity in the Planning Area. Given its location within the Salton Trough, the Coachella Valley is highly susceptible to seismic activity and seismically-induced geologic hazards. The San Andreas Fault, which accommodates the majority of movement between the Pacific and North American plates, passes directly through the Coachella Valley. The San Bernardino Mountains segment of the San Andreas Fault extends from the Cajon Pass area, east-southeast to its terminus at the northwestern city limits of Desert Hot Springs. Its strike slip rate is estimated at 22 mm/year ± 5 mm/year, and the most recent surface-rupturing earthquake on this segment is believed to have occurred in 1812.[4] The Coachella Valley segment of the San Andreas Fault crosses through the northern portion of the valley. It is creeping at a rate of about 2 to 4 mm/year, with a long-term slip rate of about 25 mm/year ± 5 mm/year.[5]

The Coachella Valley segment consists of two distinct strands: 1) the Mission Creek Fault (also known as the North Branch or San Andreas Fault strand), and 2) the Banning Fault (also known as the South Branch fault). These strands run roughly parallel to one another in the northern portion of the valley, but converge into a single strand in the southeastern Indio Hills. They continue southeast as the Indio segment, to the northeast side of the Salton Sea. These faults are believed to be capable of generating magnitude 7.1 and 7.4 earthquakes, respectively.[6] The Banning Fault is believed to have been the source of the 1986 North Palm Springs earthquake (magnitude 5.9), which resulted in extensive ground fracturing between Whitewater Canyon and State Highway 62.

Several other faults of relatively short length have been documented throughout the valley. The Garnet Hill Fault extends roughly from Whitewater Canyon to the vicinity of Edom Hill, although it is mapped as an inferred and concealed fault as it approaches Edom Hill. Others in the vicinity of Desert Hot Springs include the Devers Hill Fault, White House Canyon Fault, Blind Canyon Fault, and Long Canyon Fault. The Blue Cut Fault is located at the northeastern extreme of the Coachella Valley, along the northern flank of the Eagle Mountains. The Mecca Hills have been significantly uplifted and folded by seismic activity along the San Andreas and other faults in the vicinity, including the Painted Canyon, northern Painted Canyon, Eagle Canyon, and Grotto/Hidden Spring faults.

The Pinto Mountain and Morongo Valley Faults pass directly through the Morongo Valley portion of the planning area. The Morongo Valley Fault is a left-lateral strike-slip fault with a length of 18 kilometers and a slip rate of less than 0.5 mm/year. Probable earthquake magnitudes this fault may generate range from magnitude 6.0 to 6.8. The

[4] "Technical Background Report to the Safety Element for the General Plan of Cathedral City," Earth Consultants International, Inc., June 1999.
[5] Ibid.
[6] Ibid.

Pinto Mountain Fault is traceable for approximately 47 miles, from its junction with the Mission Creek branch of the San Andreas Fault to just east of the City of Twentynine Palms. The Anza-Borrego portion of the planning area is traversed by several active strike-slip faults of the San Jacinto Fault Zone, including the northwest-striking Coyote Creek, Buck Ridge, and Clark faults.

Other major faults and fault zones are located outside the region, but have the potential to generate strong ground shaking and other seismic hazards within the valley. The San Jacinto Fault Zone lies along the western margin of the San Jacinto Mountains, approximately 10 to 15 miles southwest of the Coachella Valley. The Elsinore Fault Zone, located about 30 miles southwest of the Coachella Valley, is one of southern California's largest fault zones (over 140 miles in length) and is capable of generating magnitude 6.5 to 7.5 earthquakes. The Mojave Shear Zone (also known as the Eastern California Shear Zone), located in the southern Mojave Desert, north of the Coachella Valley, consists of several northwest-southeast trending faults that collectively appear to be accommodating between 9 and 23 percent of the movement between the North American and Pacific plates.[7]

Geologic Hazards. Given that the planning area is traversed by, or in close proximity to numerous active and potentially active faults, it is highly susceptible to seismically-induced and other geologic hazards. Strong ground shaking is undoubtedly the most significant seismic hazard facing the Coachella Valley. According to the USGS National Seismic Hazard Mapping system, the easterly portion of the valley, generally extending from Desert Hot Springs to the northeast Salton Sea, can be expected to experience "extremely high" peak horizontal accelerations of greater than 40% the force of gravity, with a 10% probability of being exceeded in 50 years. The zones to the immediate east and west are expected to experience "very high" peak horizontal ground accelerations between 30% and 40% the force of gravity, with a 10% probability of being exceeded in 50 years. The potential ground motions likely to occur in these zones are among the highest in southern California.

Seismic activity can induce other geologic hazards, including surface fault rupture, liquefaction, slope instability, and settlement of loose, recently deposited sediments, such as windblown sand and young alluvium. When liquefaction occurs, soils behave like a liquid or fluid-like substance and settle, resulting in structural damage or failure, lateral spreading, the buoyant rise of buried structures, and/or ground oscillation. The areas most prone to liquefaction include the desert floor in the eastern valley, generally east of La Quinta, and areas adjacent to faults which act as barriers to groundwater. The potential for landslides, rock falls, debris falls, and slumps to occur within and/or adjacent to the slopes of the mountains and hillsides in the planning area is moderate to high. Such hazards can be expected to occur where bedrock is intensely jointed or fractured, and where boulders are precariously perched on hillsides and slopes. Ridge top shattering may occur on the crests of Painted Hill, Edom Hill, and other steep, narrow ridges.

[7] Ibid.

Other potential geologic hazards include hydroconsolidation, or soil collapse, which may affect the valley floor and alluvial fans, washes, and unlined drainage channels. Expansive soils, which contain significant amounts of clay particles and have the ability to give up (shrink) or take on (swell) water, typically occur within older alluvial fan deposits that emanate from mountainous slopes and within claystone layers of the Imperial Formation. Ground subsidence is the gradual settling or sinking of the ground surface with little or no horizontal movement, which in the Coachella Valley, is primarily associated with long-term groundwater extraction. Subsidence is most likely to occur in the central and southeasterly portions of the Coachella Valley, which are underlain by numerous clay layers that separate water-producing zones, and at or near the valley margins. Much of the central valley floor is also susceptible to moderate to severe wind erosion, which results in the transport and re-deposition of dry, sandy, finely granulated soils. The movement of abrasive, sandy soils can pose a serious public health hazard, reduce visibility, damage buildings and vehicles, and contribute to nutrient losses in plants.

3.3.2 Mineral Resources

Mineral resources in the planning area are largely limited to aggregate (sand, gravel, and crushed stone), which is a major component of concrete, plaster, stucco, road base, and fill and is essential to the construction industry. Important deposits of these materials occur within the region and are actively being developed. Other mineral deposits occurring in the region include copper, limestone, specialty sands, and tungsten. These deposits are limited to rocky outcroppings within the Little San Bernardino and Santa Rosa Mountains and have not been mined.

In 1988, the California Department of Conservation Division of Mines and Geology (DMG) released a report identifying aggregate materials in the Palm Springs Production-Consumption Region. The region includes 629 square miles in the Coachella Valley, generally extending from Cabazon on the west to Mecca on the east. The study found that 3.2 billion tons of aggregate resources have been identified in the region. It assigned Mineral Resource Zone (MRZ) classifications to all lands within the region, which describe the location of significant PCC-grade aggregate deposits:

MRZ-1: Areas where adequate information indicates that no significant mineral deposits are present, or where it is judged that little likelihood exists for their presence. Includes Quaternary alluvial deposits of the central upper Coachella Valley, the Imperial Formation of the Indio Hills, Garnet Hill, the hills west of Whitewater River Canyon, and the Borrego Formation of the southeastern Coachella Valley.

MRZ-2: Areas where adequate information indicates that significant mineral deposits are present, or where it is judged that a high likelihood for their presence exists. Includes the following areas: 1) Whitewater River floodplain extending from the Whitewater River Trout Farm to the City of

Palm Springs, 2) San Gorgonio River floodplain from Cabazon to its confluence with the Whitewater River, 3) the river channel in the lower part of Little Morongo Canyon, 4) a small alluvial wash north of Thousand Palms, 5) the confluent alluvial fans of Berdoo and West Berdoo Canyons, 6) the alluvial fan of Fargo Canyon, 7) an alluvial fan north of Indio, and 8) an alluvial wash and fan east of Thermal.

MRZ-3: Areas containing mineral deposits, the significance of which cannot be evaluated from available data. Includes lands composed of Cabezon Fanglomerate, Ocotillo Conglomerate, Painted Hills Formation, Palm Springs Formation, Mecca Formation, and metamorphic rocks of the San Jacinto Mountains and the San Gorgonio Complex.

The 1980 CDCA Plan, as amended, permits the development of mineral resources on BLM-administered lands in a manner which satisfies national and local needs in an economically and environmentally sound manner. All mineral exploration and mining operations are subject to the Bureau's surface mining regulations under 43 CFR 3802 and 43 CFR 3809, which prohibit "undue degradation" of public lands. Currently, all BLM actions pertaining to realty and leasable minerals are considered on a case-by-case basis in accordance with the CDCA Plan (1980, as amended). Figure 2-7 identifies the location of existing BLM mineral leases in the planning area.

Mineral resources in the Coachella Valley consist mainly of construction aggregate (sand, gravel and crushed stone). Construction aggregate is important in a variety of construction materials, including Portland cement concrete, asphaltic concrete, stucco, road base, railroad ballast, specialty sands and fill. Construction aggregate is a low-value, high bulk weight commodity, meaning that a major part of its cost to the consumer is for transportation. Aggregate resources that are unavailable locally must be brought in from more distant sources, often at greater transportation costs. Thus, locally available, high quality construction aggregate deposits are vitally important to the construction industry and development in the Coachella Valley.

Other mineral deposits occurring in the region include limited and/or small deposits of copper, limestone, gold and tungsten within the Mecca Hills, Little San Bernardino Mountains and the Santa Rosa Mountains surrounding the Coachella Valley; and are not being currently mined. Decorative stone is mined on public land in the Painted Hills, west of Desert Hot Springs. Clay deposits exist at the base of the Mecca Hills on public and private land, east of Thermal. Some of these deposits have been permitted for mining and will be used as an impermeable layer for lining landfills, ponds, and similar construction applications.

Aggregate resources in the Coachella Valley were evaluated by the California Department of Conservation, Division of Mines and Geology (DMG), now known as the California Geological Survey, (CGS) in a 1988 report entitled, Aggregate Land Classification: Aggregate Materials in the Palm Springs Production-Consumption Region. The report was part of a state-wide program to geologically delineate/classify

aggregate resources in rapidly urbanizing areas, determine quantities of available aggregate resources, and to evaluate the adequacy of permitted aggregate reserves for meeting the future needs of each region. The second part of the State's program was to designate mineral resource deposits that are of regional significance. Designated mineral resource deposits are generally those that are either currently used for mineral extraction or deposits that are open and accessible for future extraction. In the 1988 report the State classified a number of aggregate deposits that were being mined and other areas that were potentially available for future mining in the Palm Springs Production-Consumption Region. Subsequently, the State designated these deposits as regionally significant to the Coachella Valley. Local governments affected by these classifications and designations are required to develop mineral resource management policies and incorporate the classification/designation areas into their general plans, so that this information is considered in local land-use planning decisions.

The 1985 CGS report determined that the Palm Springs Production-Consumption Region has an average annual per capita consumption rate of approximately 10 tons of construction aggregate materials per year. Based on this rate and population projections made in 1985, approximately 156 million tons of aggregate materials would be needed to supply the Coachella Valley area through the year 2035 (50-year projection from 1985). Of this amount, approximately 54 percent or 84.4 million tons, must be of Portland Cement Concrete (PCC) quality (the highest grade of construction aggregate). The remainder, 46 percent or 71.6 million tons, would be lower grade construction aggregate materials, such as road base, asphalt, and fill.

The State determined that the total volume of PCC quality aggregate resources (permitted and non-permitted aggregate deposits) in the Coachella Valley was approximately 3 billion tons. Approximately 67 million tons of this total was permitted for mining in 1985. Based on the projected 50-year demand for construction aggregate in the Valley, the State concluded that these permitted deposits would be depleted in approximately 26 years (2011) from the date of analysis (1985).

In 1985 the main sources of construction aggregate that served the Coachella Valley were from alluvial fan and riverbed deposits, including the Whitewater River near Palm Springs, on a small, unnamed wash north of Thousand Palms, in west Berdoo Canyon near Indio, in the Indio Hills near Indio, and a small, unnamed canyon east of Thermal. Since 1985, deposits on the Whitewater River are no longer being mined. Other active sources identified in 1985 and still producing include the small, unnamed wash and adjacent hillsides north of Thousand Palms, west Berdoo Canyon near Indio, the south flank of the Indio Hills near Indio, and the unnamed canyon east of Thermal. New aggregate sources that were permitted after 1985 and currently producing are located on the Fargo Canyon alluvial fan near Indio. Minor amounts of aggregate are also being transported into the Valley from the Banning/Cabazon area. Sand and gravel mining operations on public land managed by the BLM in the Coachella Valley are located in the west Berdoo Canyon area near Indio (James E. Simon Co. and A-1 Aggregates) and in the unnamed canyon east of Thermal (Valley Rock and Sand/West Coast). The Coachella Valley Water District (CVWD) has operated an intermittent rip

rap mine in the west Berdoo Canyon area under a free use permit with the BLM. Figure 2-7 delineates the locations of sand and gravel mining operations on BLM land in the planning area.

Current permitted reserves in the Valley are estimated at 190 million tons (based on Riverside County and BLM permit files) on both public and private land. Approximately 10 percent of the total is located on public land managed by the BLM, with the remainder on private land. The 190 million tons of permitted reserves is a significant increase over the 1985 permitted reserve figure of 67 million tons; and is due to recent permit approvals of a large, new mine on the Fargo Canyon alluvial fan near Indio (private land), significant expansion of an existing mine in the Indio Hills also near Indio (private land), and permitting of a number of smaller operations in Thousand Palms and west Berdoo Canyon (private and public land).

Total aggregate production during 2001 in the Coachella Valley was approximately 2 million tons, of which approximately 661,000 tons were mined on BLM land in 2001. Therefore, construction aggregate production from BLM land in the Coachella Valley represented approximately one-third of the total aggregate produced in 2001.

Sand and gravel mining on BLM land in the Coachella Valley is regulated as a salable mineral in accordance with the Materials Act of 1947, as amended, the Federal Land Policy and Management Policy Act of 1976, and implementing mineral materials disposal regulations in 43 CFR part 3600. A basic goal of the mineral materials program is to make mineral materials, such as sand and gravel, available by sale or free use permit, when it will not be detrimental to the public interest, provided adequate measures are taken to protect the environment and that damage to public health and safety is minimized. BLM does not dispose of mineral materials in wilderness areas, areas where it is expressly prohibited by law (such as national monuments), and areas identified in land use plans as not appropriate for mineral materials disposal. All other BLM land containing construction aggregate deposits is open to mineral material disposal, so long as the appropriate regulations and resource management plans are followed.

The BLM process for permitting sand and gravel mining in the Coachella Valley involves a number of steps, including, but not limited to, issuance of competitive or negotiated contracts to the mining companies, preparation of mining and reclamation plans by the operator, NEPA compliance and environmental assessment, consultation with appropriate resource agencies, development of mitigation measures and operating stipulations, mining and reclamation plan approval, and inspection and product verification during operations. All mining operations on BLM land in the Valley are also required to obtain reclamation plan and reclamation bond approval from Riverside County, the lead agency for implementing the California Surface Mining and Reclamation Act (SMARA).

One surface mining operation currently operates with unpatented mining claims located on BLM land in the Coachella Valley plan area. The mine, located in the Painted Hills

area, is a decorative stone quarry operated by Whitewater Rock and Supply, and has been in operation since the early 1950's. Surface mining operations on unpatented mining claims, such as the Whitewater Rock and Supply quarry, are subject to the surface management regulations in 43 CFR part 3809. Plans of operation, reclamation plans and reclamation bonds are required for these types of operation.

There are no existing mineral leases on BLM land within the Coachella Valley. Leasable minerals include certain solid minerals such as sodium, potassium and phosphate; and fluid minerals such as oil and gas and geothermal resources. Although no leasable minerals are currently being exploited on BLM land in the planning area, it should be noted that the Geology, Energy, and Mineral Element of the CDCA Plan, as amended, indicated that the Coachella Valley is prospectively valuable for oil and gas and geothermal resources, since the area has similar geologic conditions to other areas where these mineral resources have been extracted.

3.3.3 Energy Resources

The 1980 CDCA Plan, as amended, allows for the designation of utility corridor rights-of-way and the development of power plants and alternative energy sites on BLM lands.

Electrical Power. Southern California Edison (SCE) and the Imperial Irrigation District (IID) provide electric power services to the Coachella Valley. Both companies utilize a combination of hydroelectric, thermal, diesel, and geothermal power sources, most of which are located outside the valley. Electricity is distributed to the Coachella Valley via high-voltage (up to 500 kilovolts) transmission lines, which cross the valley along an east-west trending utility corridor north of Interstate-10. This corridor passes directly through or in close proximity to various parcels administered by BLM.

Natural Gas. Natural gas is found in association with petroleum crude oil deposits and is generally considered a clean and efficient fuel. The Southern California Gas Company provides natural gas services to much of the Coachella Valley. The fuel is transported from Texas to the Coachella Valley through three east-west trending gas lines, which cross the valley just north of Interstate-10 and continue west to Los Angeles. The pipelines include one 30-inch line and two 24-inch lines, with pressures of 2,000 pounds per square inch (psi). The pipeline utility corridor passes directly through or in close proximity to various parcels administered by BLM.

Wind Energy. The Coachella Valley's wind energy industry has proven to be an important renewable energy resource. According to the American Wind Energy Association, in January 2002, there were 19 different wind energy projects in the San Gorgonio Pass area, with a combined installed power capacity of 421.1 megawatts. In 1998 (the last year for which data are available), they generated an annual energy output of 805 million kWh. Another five wind energy projects, with a combined power capacity of 163.5 megawatts, are proposed for construction during 2002.

BLM's CDCA Plan (1980, as amended) allows for the development of windfarms on BLM-administered public lands in an environmentally sound manner. Project review and approval is conducted on a case-by-case basis. Figure 2-7 identifies the location of existing wind energy parks on BLM lands in the planning area.

Solar Energy. Solar thermal systems are widely applied in the Coachella Valley for heating domestic water and swimming pools. However, such uses are largely limited to private lands.

Geothermal Energy. Geothermal resources are plentiful in the northwestern portion of the Coachella Valley. Geothermal hot springs in Desert Hot Springs are structurally controlled by faults and largely focused along the Mission Creek fault. The geothermal energy produced in Desert Hot Springs, which is primarily used for commercial spas and therapeutic pools, is harnessed on private land and does not affect lands administered by BLM.